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D E C I S I O N
of 27 September 2005

Case Number: T 0924/03 - 3.4.02

Application Number: 99929950.6

Publication Number: 1090287

IPC: G01N 290/00

Language of the proceedings: EN

Title of invention:
Acoustic transit time measuring system

Applicant:
Van Schaik, Wilhelm Henricus Jurrian

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 83

Keyword:
"Insufficient disclosure"

Decisions cited:
T 0475/88, T 0772/89, T 0206/83, T 0654/90, T 0676/94

Catchword:
-



Case Number: T 0924/03 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 27 September 2005

Appellant: Van Schaik, Wilhelm Henricus Jurrian
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 20 February 2003
refusing European application No. 99929950.6
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: A. Klein
Members: A. G. Maaswinkel
C. Rennie-Smith

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal, received on 22 April 2003, against the decision of the examining division, dispatched on 20 February 2003, refusing the European patent application No. 99929950.6. The fee for the appeal was paid on 23 April 2003. The statement setting out the grounds of appeal was received on 1 July 2003.

II. In its decision, the examining division held that the patent application did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 83 EPC). In particular the examining division objected that it was not clear from the wording of claim 1 what kind of model for the medium was meant and that neither the claims nor the description provided a satisfying definition of this concept. According to the decision, the documents referred to by the applicant (including those listed below) constituted very specific scientific publications which could not be regarded as common general knowledge, in particular because they were either not cited in the original patent application (E1, E2, A5 to A8) or did not provide the missing information (textbook A1).

A1: R.P. Feynman et al.: "The Feynman Lectures on Physics", Addison-Wesley Publishing Company, 1977, vol. 1, pages 31-6 to 31-9 and page 47-7.

A5: G.S.K. Wong, "Speed of sound in standard air", 1986, J. Acoust. Soc. Am., vol. 79, nr. 5, pages 1359 to 1366.

- A6: M. Greenspan, "Comments on "Speed of sound in standard air" [J. Acoust. Soc. Am. 79, 1359-1366(1986)]", 1987, J. Acoust. Soc. Am., vol. 82, nr. 1, pages 370 to 372.
- A7: G.S.K. Wong, "Response to "Comments on "Speed of sound in standard air" [J. Acoust. Soc. Am. 82, 370-372 (1987)]", 1987, J. Acoust. Soc. Am., vol. 82, nr. 1, pages 373 and 374.
- A8: A.J. Zuckerwar et al., "Low-frequency absorption of sound in air", 1985, J. Acoust. Soc. Am., vol. 78, nr. 3, pages 946 to 955.
- E1: O. Cramer: "The variation of the specific heat ratio and the speed of sound in air with temperature, pressure, humidity, and CO₂ concentration", 1993, J. Acoust. Soc. Am., vol. 93, nr. 5, pages 2510 to 2516.
- E2: G.S.K. Wong: "Comments on "The variation of the specific heat ratio and the speed of sound in air with temperature, pressure, humidity and CO₂ concentration" [J. Acoust. Soc. Am. 93, 2510-2516 (1993)]", 1995, J. Acoust. Soc. Am., vol. 97, nr. 5, pages 3177 to 3179.
- III. In the statement of grounds of appeal the appellant requested that the set of claims on which the decision under appeal was based be considered as its main request and it also filed two further sets of claims as its first and second auxiliary requests. In its opinion, the closest prior art for these new requests was:

- D4: M. Vestrheim et al.: "Transit time determination in a measurement system, with the effects of transducers", 1996 IEEE Ultrasonics Symposium, pages 665 to 668.
- IV. In a Communication pursuant to Article 11(1) RPBA accompanying the summons to oral proceedings on 27 September 2005, the board expressed its doubts as to whether the documents referred to by the applicant (E1, E2, A5 to A8) could be regarded as "*common general knowledge*" and that, apart from the objection under Article 83 EPC, it was questionable whether the patent application met the provisions of Article 84 EPC and Rule 27(1)(e) EPC.
- V. With a facsimile letter of 22 September 2005 the appellant filed an amended claim 1 of the first auxiliary request.
- VI. Oral proceedings took place on 27 September 2005. The board gave its decision at the end of the oral proceedings.
- VII. The wording of claim 1 of the main request reads as follows:
- "A method for determining a physical quantity within a measuring space (4) by means of acoustic transit time measurement, using at least one acoustic transmitting transducer (2) and at least one acoustic receiving transducer (6),
- characterised by signal processing based on a comparison in a discrete manner (8) between

- a) a predicted distorted acoustic signal transmitted through said space, based on models (12) for the medium and measuring space concerning the distortion to which the signal is subjected within the measuring space and on the transmitted signal, and
- b) the actual measured (5) acoustic signal transmitted through said space, in order to determine the acoustic transit time".

The wording of claim 11 of this request reads:

"An apparatus to implement a method as claimed in any one of the preceding claims, comprising at least one measuring space (4, 20) containing a medium of which one or more physical quantities are to be determined by means of acoustic transit time measurement, which space is provided with at least one acoustic transducer (2, 22, 28) and at least one acoustic receiver (6, 24, 28), characterised in that means (8, 10, 12) are furthermore present which predict the distortion of an acoustic signal transmitted through said space, based on models (12) for the medium and measuring space concerning the distortion to which the signal is subjected within the measuring space and on the transmitted signal, and which compare in a discrete manner (8) said predicted acoustic signal with the actual measurement of the received acoustic signal (5) transmitted through said space, in order to determine the acoustic transit time".

Claims 2 to 10 and 12 and 13 of this request are dependent claims.

VIII. The wording of claim 1 of the first auxiliary request reads as follows:

"A method for determining a physical quantity within a measuring space (4) by means of acoustic transit time measurement, using at least one acoustic transmitting transducer (2) and at least one acoustic receiving transducer (6), using signal processing based on a comparison in a discrete manner (8) between

a) a predicted distorted acoustic signal transmitted through said space, based on models (12) for the medium and measuring space concerning the distortion to which the signal is subjected within the measuring space and on the transmitted signal having a frequency, and
b) the actual measured (5) acoustic signal transmitted through said space, in order to determine the acoustic transit time

characterized by the determination of a time window based on the frequency of the transmitted acoustic signal and the speed of sound; the use of at least two selected points located on the slope and at the top of the received acoustic signal respectively within said determined time window, which points are used for combined signal top - signal slope detection wherein said point located on the slope is selected as being the point distinguishing the actual measured (5) acoustic signal from enviromental [sic] influences and wherein said point located on the top is detected within said time window".

The wording of claim 10 of this request reads as follows:

"An apparatus to implement a method as claimed in any one of the preceding claims, comprising at least one measuring space (4, 20) containing a medium of which one or more physical quantities are to be determined by means of acoustic transit time measurement, which space is provided with at least one acoustic transducer (2, 22, 28) and at least one acoustic receiver (6, 24, 28) and means (8, 10, 12) which predict the distortion of an acoustic signal transmitted through said space, based on models (12) for the medium and measuring space concerning the distortion to which the signal is subjected within the measuring space and on the transmitted signal, and which compare in a discrete manner (8) said predicted acoustic signal with the actual measurement of the received acoustic signal (5) transmitted through said space, in order to determine the acoustic transit time,

characterised in that one or more acoustic mirrors (44) folding the measurement path are included, which maximise the length of the acoustic trajectory (46) between the sending (40) and/or receiving transducers (40) in the available measuring volume (42)".

Claims 2 to 9 and 11 of this request are dependent claims.

IX. The wording of claim 1 of the second auxiliary request reads as follows:

" A method for determining a physical quantity within a measuring space (4) by means of acoustic transit time measurement, using at least one acoustic transmitting transducer (2) and at least one acoustic receiving

transducer (6), using signal processing based on a comparison in a discrete manner (8) between

a) a predicted distorted acoustic signal transmitted through said space, based on models (12) for the medium and measuring space concerning the distortion to which the signal is subjected within the measuring space and on the transmitted signal, and

b) the actual measured (5) acoustic signal transmitted through said space, in order to determine the acoustic transit time

characterized in that the acoustic signal transmitted by the transmitting transducer is reflected through the measuring space one or more times via acoustic reflection over the same path in order to measure the local physical quantity in an optimal way and to reduce the influence of external factors, like environmental temperature, before being received by the receiving transducer, which may or may not be the same as the transmitting transducer".

The wording of independent claim 10 of this request is identical to that of claim 10 of the first auxiliary request. Claims 2 to 9 and 11 are dependent claims.

X. The arguments of the appellant may be summarised as follows.

The refusal of the patent application by the examining division because of lack of disclosure (Article 83 EPC) was based on an incorrect interpretation of the principle of common general knowledge. The documents designated with E1 - E6 and A1 - A8 can be regarded as common general knowledge since they represent information readily available to the skilled man in the

field of the subject of the present invention, i.e. the field of acoustics, who should have all kinds of literature relating to this technical field available to him. In this particular field of technology an extensive discussion was conducted between several persons over a period of some 10 - 15 years about the formulation, draft and use of theoretical models for the prediction of the distortion of an acoustic signal propagating through a medium space. In the field of acoustics this discussion concerning such models is a major and important subject and thus widely known. The contributions of Mr Owen Cramer and Mr George S.K. Wong are especially well known. Reference was made to the Decisions T 206/83 and T 654/90, where it was decided that information which can only be obtained after a comprehensive search in the literature is not be regarded as part of the common general knowledge. The appellant submitted that publications E1 - E6 and A1 - A8 are to be regarded as part of the common general knowledge simply because this information can easily be obtained by the skilled man without performing a comprehensive search. These publications are all widely known due to the long lasting (10 - 15 years) and intense discussion of such models.

Furthermore, with respect to the objection in the decision that it is not clear from the wording of claim 1 what kind of model for the medium is meant, it is stated that the skilled person in the art knows - when reading the claims - what is meant by the models defined in claim 1 and which model he can use - based on common general knowledge - in order to carry out the invention. One such model is for example disclosed in document A1 "The Feynman Lectures on Physics", or in E1

the article of Mr Owen Cramer (the model actually used by the inventor), or in E2 of Mr George S.K. Wong, or in A5 by Mr George S.K. Wong and or in A6 of Mr Martin Greenspan.

The textbook A1 discloses in equation (47.23) a relationship between the speed of sound in a medium c_s^2 and the temperature T and molecular weight μ . The speed of sound can be measured as in the set-up shown in Figure 2c or 2d of the patent application. This involves the measurement of the transit time t for a chamber of length d by the relation $c_s=d/t$, as is well-known from elementary physics. In the embodiment of Figure 2c a reference chamber, filled with a medium of known composition, is positioned next to the actual measurement chamber. This enables direct absolute measurements to be carried out. In the set-up of Figure 2d, discussed on page 13, lines 25 to 29, a temperature detector is included which allows determination of the composition or humidity of a gaseous mixture (via the molecular weight μ in the equation of speed of sound, the temperature T being known).

Since, as shown by the preceding discussion, there are a number of models the skilled person can apply, and since the patent application discloses different physical quantities that may be determined by the measurement process (temperature, humidity, gas composition), the appellant considered that the scope of claim 1 is not too broad and that it is fairly supported by the description. Finally reference was made to the patent documents cited in the original description (WO93/0057 and GB-A-2 235 294) from which

the skilled person could obtain further technical information about the underlying acoustic transit time measurements.

As to claim 1 of the first auxiliary request, this is a combination of former claim 1 and former claim 3. This claim 1 is directed to a specific and accurate calculation technique. The closest prior art is document D4, which discloses a calibration method for calibrating an ultrasonic flowmeter at representative zero-flow conditions. With this calibration technique no measurement of physical quantity of a medium in a measuring space is disclosed or is possible. The model disclosed in D4 is obtained in an experimental way by trial and error, such that a transfer function is measured only in the neighbourhood of the resonance frequency of the transducers using successive zero crossings (see page 665, second paragraph right column). The current application uses a prediction of the distortion of the signal based on preselected theoretical models so every signal frequency can be used. Another difference is the used signal to determine a transit time. The signal properties in the current application are based on uniqueness, see for example the embodiment in Figure 4. The characteristics of the signal identification are time unique points on the interval which are chosen for clear identification and to provide a maximum signal amplitude and a minimum of noise. Both points for the signal detection are both above the noise level (slope and top). The top is the maximum possible amplitude with optimal S/N ratio. D4 however uses a number of zero crossings within the noise area, and said multiple measurements are therefore greatly disturbed and inaccurate. Further,

due to the multiple measurements reflections can influence the accuracy of the result obtained. Preferably two points of the signal used in the measurement system according to the invention will determine the identification, thus preventing distortion of the signal by unwanted reflections or interactions of the signal. With the two mentioned measurement points the change in the shape of the signal due to the dispersion and damping can easily be measured and compensated for. Hence, unlike the technique disclosed in D4, with the signal processing according to the invention it is possible to perform this signal processing both speedily and more accurately.

As to the second auxiliary request, claim 1 is a combination of former claim 1 and former claim 2. The characterising features of former claim 1 are now introduced in the preamble of the new claim 1 and the characterising features of former claim 2 are now the characterising features of new claim 1. Document D4 is again the closest prior art.

Reasons for the Decision

1. The appeal is admissible.
2. *Main request*
 - 2.1 Claim 1 defines a method of determining a physical quantity within a measuring space by means of acoustic transit time measurement using a transmitting and a receiving transducer. As reflected in the two-part form

of the claim, such measurement methods are known. The expressions "physical quantity" and "measuring space" are in a generic form, thus reflecting the disclosure in the patent application, wherein various quantities to be measured (temperature, relative humidity, CO₂-content) are referred to and also several examples of measurement environments are outlined (Figure 2).

2.2 According to the characterising portion of this claim, a comparison in a discrete manner is carried out between the actually measured acoustic signal and a predicted distorted acoustic signal which is based on models for the medium and measuring space concerning the distortion to which the signal is subjected. Thus the invention as claimed resides in the use of a model describing the characteristics of the medium within the measurement chamber in order to predict the signal distortion in the acoustic path (see page 10, lines 35 to 38 of the description). Similarly independent apparatus claim 11 defines "means (8, 10, 12) ...which predict the distortion of a transmitted acoustic signal". The reference signs 8, 10 and 12 correspond to the "signal processing unit", "measurement data processing unit" and "knowledge unit" shown in the block diagram of Figure 1.

2.3 Neither the independent claims 1 and 11, nor the further dependent claims provide further details concerning "model", "predict" or "distortion" which must be considered as key elements of the claimed invention. The provisions of Article 83 EPC require that a European patent application must provide sufficient information to enable the skilled person to carry out the invention. Reference is also made to the

provisions of Rule 27(1)(e) EPC according to which the description must describe in detail at least one way of carrying out the invention claimed using examples where appropriate and referring to the drawings, if any.

2.4 The block diagram shown in Figure 1 is addressed on page 10 of the description, starting at line 13. According to the passage at lines 17 to 21 on this page, the knowledge unit is *"the intelligent, adaptive knowledge and control unit of the knowledge-based and rule-based measuring system, which contains knowledge and instructions"* and this unit *"contains a discrete model of the signal to be transmitted"*. Furthermore it *"also contains models of the measuring medium and the measuring chamber, which describe the influences the signal undergoes along the measurement path, allowing the acoustic signal distortion and the reflections to be predicted"* (lines 28 to 32). Finally, at lines 35 to 38 it is stated *"The medium model describes the characteristics of the medium within the measuring chamber as regards the propagation of sound, insofar as these relate to signal distortion in the acoustic path"*.

2.5 The subsequent part of the description does not disclose any further information regarding a model for the medium which allows prediction of the distortion encountered by an acoustic signal if propagated through the medium. There is also no reference made to literature or patent documents from which the skilled person would understand what the underlying technical model was. The patent literature referenced in the description is of no avail: the patent number W093/0057 referred to on page 1, line 9 of the description does not exist; document GB-A-2 235 294, referred to on

page 9, line 21, relates to improvements in acoustic tomography by employing an array of acoustic transducers around a plane area of interest. According to its description, a temperature can be calculated by using the measured velocity of sound, therefore the underlying principle used in this document corresponds to the features in the preamble of claim 1 and in any case this document does not provide a model of, or any information concerning, distortion of the acoustic signal.

- 2.6 The appellant has argued that documents E1 - E6 and A1 - A8 can be regarded as common general knowledge as they represent information readily available to the skilled person in the field of acoustics who would be familiar with all kinds of literature in that field. With respect to "*common general knowledge*", the board refers to Singer/Stauder, The European Patent Convention Third Edition, Volume 1 (Heymanns, Sweet & Maxwell, 2003), "Article 83", note 18, page 359. Here it is stated that "*Thus an application need not reiterate points which belong to the fundamental knowledge of the skilled person, as found regularly in the standard textbooks and standard literature for a specific field. Also included under common general knowledge is information that the skilled person can find by merely turning to known source material, which, it is assumed, he refers to when necessary. Examples of such works are encyclopaedias and common reference works. On the other hand, information which would only be obtained by a search is not included under general knowledge. This generally applies to the information found in technical or scientific periodicals, even if they are considered to be standard reading for the*

field (T 475/88 of 23 November 1989; for an exception, see T 676/94 of 6 February 1996), and in patent literature." The appellant submitted that publications E1 - E6 and A1 - A8 had been widely available over a period of some 10 - 15 years, which, in the opinion of the board, is evidence that that this is an *established* technical field and that the exception referred to in T 676/94 does not apply (see also T 772/89, point 3.3 of the Reasons). Therefore these documents (with the exception of textbook A1) are not considered as standard reading. Further, the board notes that this approach to "common general knowledge" was applied in the same way in the Decisions T 206(83 (see point 5 and 6 of the Reasons) and T 654/90 (point 2.4 of the Reasons).

2.7 As to the textbook A1, the appellant had referred to equation (47.24) which defines a relation between the speed of sound c_s , the temperature T and the molecular weight μ in a gas ($c_s^2 = \gamma RT / \mu$). The board concurs with the appellant that this relation may be seen as part of the "common general knowledge" and it is expected that it is this relation that was used as a "model" in the GB-'294 patent document referred to in the present patent application.

2.8 The above equation (47.24), however, does not describe a "distortion" of the acoustic signal: a "distortion" of a signal would imply a change in the signal's waveform or shape. This equation does not define signal amplitude, frequency or phase. It does not contain any damping mechanism or dispersion equation. Therefore it would not be possible for the skilled person to

- reproduce or carry out the method defined in claim 1 on the basis of the teaching of textbook A1.
- 2.9 In conclusion the description does not clearly describe one way to perform the invention as defined in claim 1; the sole references in the description to further literature (patent documents WO'57 and GB'294) do not contain any information concerning models predicting the distortion of a propagating acoustic signal; nor does the textbook literature document A1 referred to by the appellant disclose any such information. All the further documents relied on by the appellant are very specialised scientific literature documents, which cannot be considered as forming "common general knowledge". In particular, because the language in claim 1 is of a very broad, generic character (see point 2.1 supra) and the description envisages a very wide area of possible applications, the skilled person is not supplied with any indication where he should look for the underlying model(s) in the literature.
- 2.10 When filing a European patent application the applicant requests that a monopoly be granted to him. It is a basic principle of patent law that, as the "quid pro quo" for such a monopoly, the invention must be "disclosed", i.e. made available, in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 83 EPC) so that this disclosure can serve as a basis for further technical progress. For the subject-matter defined in claim 1 this is not the case. Claim 1 is therefore not allowable.

2.11 Independent claim 11 suffers from the same deficiencies as claim 1, therefore this claim is not allowable either.

2.12 It is concluded that the patent application including the set of claims of the main request does not meet the provisions of Article 83 EPC.

3. *First and second auxiliary requests*

3.1 The independent claims of these requests (claims 1 and 10 of both the first and second auxiliary requests) define methods for determining a physical quantity within a measuring space by means of acoustic time measurement and the corresponding apparatus to implement this method. In the method claims a comparison in a discrete manner is carried out between a predicted distorted acoustic signal transmitted through said space, based on models for the medium and measuring space concerning the distortion to which the signal is subjected within the measuring space and on the transmitted signal, and the acoustic signal actually measured. The invention defined by these claims is therefore based on the application of the same models as in the claims of the main request.

3.2 The only difference in this respect to the claims of the main request is that in the claims of the auxiliary requests the objected features are now in the preamble of the claims. The applicant has argued that the two-part form of these claims is based on the disclosure in document D4 as the closest prior art. Since this document had not been referred to in the original application, the skilled person would not have been

aware of the existence of this scientific publication, which, furthermore, cannot be considered as "common general knowledge".

3.3 The further features in the characterising portion of these claims do not provide the lacking information: claim 1 of the first auxiliary request defines in its characterising portion signal processing features of the measured acoustic signal and do not relate to a model with which a distorted signal can be predicted. Claim 10 of the first auxiliary request and claims 1 and 10 of the second auxiliary request define the use of acoustic mirrors which is also not related to the missing information.

3.4 Hence, irrespective of whether the features objected to are included in the preamble or in the characterising portion of the claims, the skilled person could not carry out the invention without undue burden. These claims are therefore not allowable for the same reason as the claims of the main request.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

P. Martorana

A. Klein